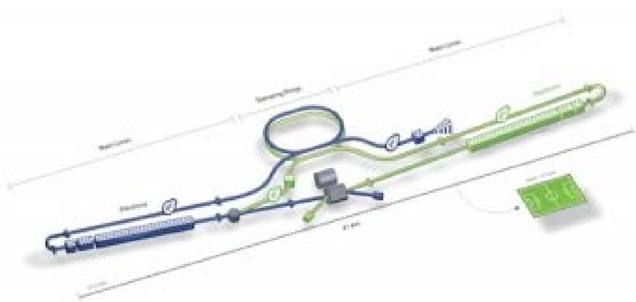
AROUND THE WORLD



Building the ILC step by step

by Rika Takahashi

The Japan association of high-energy physicists has published a proposal of “phased execution” for the International Linear Collider which was accepted by the Japanese high-energy physics community. The so-called phased execution or staged approach is the plan to build a shorter ILC accelerator than the one designed in the ILC TDR, as a first step of the project.

FEATURE

Viewpoint: Charting the future of European particle physics

From CERN Courier: Tatsuya Nakada considers what the updated European Strategy for Particle Physics needs to address.

The original CERN convention, which was drafted nearly 60 years ago, foresaw that the organization should have a role as co-ordinator for European particle physics, as well as operating international accelerator laboratories. Today, this role is more appropriate than ever: the long lead times usually required to prepare and construct facilities and experiments for modern high-energy physics, together with the increased costs for these activities, underlie the need for a general European strategy in the field. So it was natural for CERN Council to initiate the creation of a European Strategy for Particle Physics in June 2005 and to establish dedicated groups for reviewing the scientific status and producing a proposal. They consulted widely with the community, funding agencies and policy makers in preparing the strategy document, which was adopted by Council in July 2006 during a dedicated session in Lisbon.

DIRECTOR'S CORNER

Special Linear Collider Event during the IEEE Symposium

by Barry Barish

The Institute of Electrical and Electronics Engineers (IEEE) held a “Special Linear Collider Event” as part of their 2012 Nuclear Science Symposium and Medical Imaging Conference at Anaheim, California. The special event, held on 29 and 30 October, came on the heels of the discovery of a Higgs-like particle at the LHC at CERN this summer and included an array of leaders in the field. There were presentations on the International Linear Collider (ILC) and Compact Linear Collider (CLIC) accelerators as well as detector concepts, the potential impact of the LC technologies for industrial applications and a forum discussion about future LC perspectives.

FEATURE

From symmetry magazine: What else could the Higgs be?

According to the Standard Model, the mass of the Higgs boson should be enormous. But recent experimental results suggest it's quite small, indicating that scientists might need to go beyond the Standard Model to explain the new particle.

IN THE NEWS

from ***Huffington Post***
6 November 2012
NASA Galaxy Animation: Star Cluster's Birth, Growth Seen In Computer Model (VIDEO)
Though it lacks a killer soundtrack and isn't as high-definition as you might expect, this NASA simulation of a disk galaxy's birth and development is incredible to watch.

from ***St Charles Patch***
5 November 2012
Fermi Physicists—Let's Get Ready to Rumble!
A the first-ever Nov. 16 Physics Slam, five physicists will get 12 minutes to explain a complex scientific concept to the audience in the most clear and entertaining way possible.

from ***Star Telegram***
3 November 2012
Physicists pursuing a new accelerator try to convince public of its worth
In the world of high-energy physics, to borrow from Field of Dreams, if you build it, they may come.

CALENDAR

UPCOMING EVENTS

TESLA Technology Collaboration (TTC) Meeting
Thomas Jefferson National Accelerator Facility
05- 08 November 2012

FCAL Collaboration meeting
CERN, Geneva
12- 14 November 2012

Accelerators for a Higgs Factory: Linear vs. Circular (HF2012)
Fermilab
14- 16 November 2012

UPCOMING SCHOOLS

CERN Accelerator School: Introduction to Accelerator Physics

University of Granada, Granada, Spain
28 October- 09 November 2012

Seventh International Accelerator School for Linear Colliders
Indore, India
27 November- 08 December 2012

View complete calendar

ANNOUNCEMENTS

Remember, remember: no ***NewsLine*** next week
Until the start of the new linear collider organisation in February 2013, ILC NewsLine will be published once every two weeks, so there will be no issue of ILC NewsLine next week. Due to Thanksgiving, the next issue will be published on 21 November.

PREPRINTS

ARXIV PREPRINTS

1211.1112
Full $\mathcal{O}(\alpha)$ electroweak radiative corrections to $e^+e^- \rightarrow t \bar{t} \gamma$ with GRACE-Loop

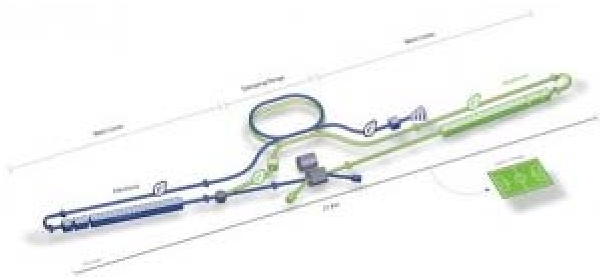
1211.0634
Effective Field Theories and the Role of Consistency in Theory Choice

1211.0311
Delta r in the Two-Higgs-Doublet Model at full one loop level — and beyond

AROUND THE WORLD

Building the ILC step by step

Rika Takahashi | 8 November 2012



Schematic image of the ILC accelerator. For the staged approach, the main linac could be shorter than the planned length in the Technical Design Report.

On 18 October, a meeting of Japanese high-energy physicists to discuss a “phased execution” of the International Linear Collider was held at KEK laboratory, Tsukuba, Japan.

This meeting was hosted by JAHEP, the Japan association of high-energy physicists, and was called an “expanded” meeting. JAHEP usually hold regular meetings with 15 committee members who were elected by the Japanese HEP community. “We hold expanded version of the meeting to promote open and wide discussion by community members on important issues,” said Sachio Komamiya, Chair of the JAHEP. “We recognised the ILC as an urgent priority of the community, and decided to hold the extended meeting.”

Why does the Japanese HEP community see ILC as an urgent priority?

JAHEP accepted the March 2012 recommendations of the Subcommittee on Future Projects of High Energy Physics and adopted them as JAHEP’s basic strategy for future projects. Then in July 2012 a new particle consistent with the Higgs boson was discovered at CERN’s Large Hadron Collider, and in December 2012 the *Technical Design Report* (TDR) and *Detailed Baseline Design* (DBD) report of the ILC will be completed by the worldwide collaboration.

In addition to those developments, a national budget were allocated for geological investigations for two Japanese candidate sites, Kitakami in Iwate prefecture, and Sefuri located between Saga and Fukuoka prefectures. “Also we see the rise of worldwide community’s expectation towards Japan,” says Komamiya.

The so-called phased execution (or staged approach) is the plan to build a shorter ILC accelerator than the one designed in the ILC TDR, in the beginning of the project as a Higgs factory.

The baseline design foresees an ILC that is about 31 kilometres long and provides a centre-of-mass energy of 500 GeV. The phased execution plan targets a lower energy of 250 GeV as a first phase, because of the mass of Higgs-like particle discovered by LHC in July – 126 GeV. “New physics starts at 126 GeV. So, a 250-GeV machine, which can produce tons of those particles with 126 GeV mass, will bring us a great possibility to find a law of new physics at a stretch,” said Satoru Yamashita of University of Tokyo, who gave a talk on ILC physics case at the meeting. “We can take best advantage of the linear accelerator. The circular machines have a limitation on the extension of the length of the accelerator tunnel, but a linear collider has flexibility. We can extend the machine as experiment goes.”

Following Yamashita, Akira Yamamoto, one of the project managers of the GDE, explained the R&D status of the ILC accelerator. He summarised the R&D activities, and wrapped up his talk by saying “the ILC can be built, based on the TDR technology.” However, the TDR deals with the baseline machine of a 500-GeV accelerator, and the theme of the discussion of the meeting, phased execution, won’t be described as a main goal, but briefly discussed in the chapter on the possible upgrade and staging options.

After two hours of discussion, the attendees agreed to publish a “Proposal for a Phased Execution of the International Linear Collider Project” in the following scenario:

> *(1) Physics studies shall start with precision study of the “Higgs Boson” and will evolve into studies on top quark, “dark matter” particles, and Higgs self-couplings, by upgrading the accelerator. A more specific scenario is as follows:*
>
> *(A) A Higgs factory with a centre-of-mass energy of approximately 250 GeV shall be constructed as a first phase.*
>
> *(B) The machine shall be upgraded in stages up to a center-of-mass energy of ~500 GeV, which is the baseline energy of the overall project.*
>
> *(C) Technical extendability to a 1 TeV region shall be secured.*
>
> *(2) A guideline for shares of the construction costs is that Japan covers 50% of the expenses (construction) of the overall project of a 500-GeV machine. The actual shares, however, should be left to negotiation among the governments.*

Some meeting attendees expressed their concern about the ILC to be realised in Japan: the ILC might be the only high-energy physics project in Japan, since the ILC is a huge project that might eat up all of the budget. To respond the concern, Atsuto Suzuki, Director General of KEK, said, “as scientists, we all need to think of the way to realise something. If you always think based on your limited knowledge, experience, or prejudice, you cannot make things happen, especially something big like the ILC. It’s no use to make a judgment based only on the data you have now. You need to be foolish sometimes.”

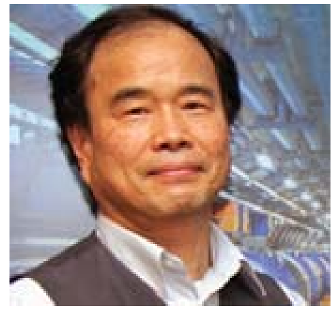
The full text of the recommendation is available at the JAHEP website .

JAPAN

Nov 6, 2012

Viewpoint: Charting the future of European particle physics

Tatsuya Nakada considers what the updated European Strategy for Particle Physics needs to address.


Nakada

The original CERN convention, which was drafted nearly 60 years ago, foresaw that the organization should have a role as co-ordinator for European particle physics, as well as operating international accelerator laboratories. Today, this role is more appropriate than ever: the long lead times usually required to prepare and construct facilities and experiments for modern high-energy physics, together with the increased costs for these activities, underlie the need for a general European strategy in the field. So it was natural for CERN Council to initiate the creation of a European Strategy for Particle Physics in June 2005 and to establish dedicated groups for reviewing the scientific status and producing a proposal. They consulted widely with the community, funding agencies and policy makers in preparing the strategy document, which was adopted by Council in July 2006 during a dedicated session in Lisbon.

The strategy consists of 17 concise descriptions, with action statements (*CERN Courier* September 2006 p29). It addresses not only scientific issues but also subjects such as the organization and social relevance of high-energy physics. The highest priority on the scientific programme was given to the LHC, followed by accelerator R&D for possible future high-energy machines, including the luminosity and energy upgrades of the LHC, linear e^+e^- colliders and neutrino facilities.

CERN Council adopted this strategy in 2006 with an understanding that it be brought up to date at intervals of typically five years. The first update is now being prepared for presentation to Council in 2013, the process having been postponed for two years to wait for data from the LHC at energies of 7 and 8 TeV in the centre of mass. As a result, in addition to the recent discovery at the LHC of a new boson that is compatible with the Standard Model Higgs particle, the third mixing angle of the neutrino mass-matrix has become known through experiments elsewhere.

These new results generate more scientific questions compared with 2006, such as:

• How far can the properties of the Higgs(-like) particle be explored at the LHC, with the 300 fb^{-1} of data expected for Phase 1, and with the 1000–3000 fb^{-1} (1–3 ab^{-1}) that the high-luminosity upgrade should yield? Do we need other machines to study the particle's properties? If so, after taking into account factors such as the technical maturity, energy expandability, cost and location, what is the optimal machine: a linear or circular e^+e^- collider, a photon collider or a muon collider? As a more concrete question, what should the European reaction be towards the linear collider that is being considered in Japan?

• The European neutrino community is putting forward a short-baseline neutrino programme to search for sterile neutrinos, as well as a long-baseline one to measure neutrino-mass mixing parameters, to take place in Europe. In addition, R&D studies are underway for a "neutrino factory" as an eventual facility. But, what should the European neutrino programme be, and where does the global aspect start to play a role?

• What are the options for a future machine in Europe after the LHC? Will this be a machine to address physics at the 10 TeV energy scale? Will data from the LHC at the full design energy provide enough justification for this? When will be the right moment to take a decision, and what kind of R&D must be done to be ready for such a decision in the future?

Breakthroughs in science can emerge from unexpected corners. Therefore, the strategy must also have some flexibility to allow the fostering of unconventional ideas.

The process of updating the European strategy began formally in the summer of 2011 when Council set up a new European Strategy Group, which is assisted by the European Strategy Preparatory Group for scientific matters in preparing the proposal for the update. As with the process that led to the original strategy, the proposal will be based on the maximum input from the particle-physics community, as well as from other stakeholders – both inside and outside Europe. An important part of this consultation process was the Open Symposium recently held in Krakow, where the community expressed their opinions on the subjects outlined above, as well as on flavour physics, strong-interaction physics, non-accelerator-based particle physics and theoretical physics. Issues important for carrying out the research programme, such as accelerator science, detector R&D, computing and infrastructure for large detector construction, were also addressed. The meeting demonstrated that there is an emerging consensus that new physics must be studied both by direct searches at the highest-energy accelerator possible, as well as by precision experiments with and without accelerators.

The Preparatory Group is in the process of producing a summary document on the scientific status. The European Strategy Group will meet in January 2013 in Erice to draft the updated strategy – which must also take global aspects into account – for discussion by CERN Council in March. The aim is that Council will adopt the updated strategy during a special session to be held in Brussels in May.

• Further information on the update of the European Strategy of Particle Physics may be found athttps://europeanstrategygroup.web.cern.ch/EuropeanStrategyGroup/.

About the author

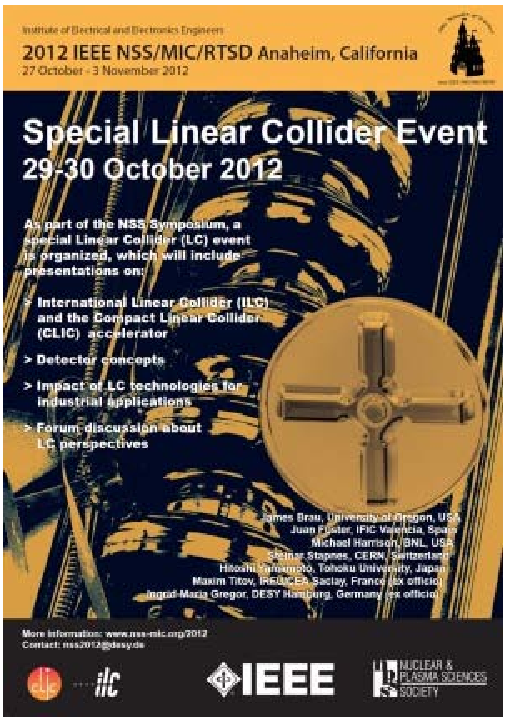
Tatsuya Nakada, École Polytechnique Fédérale de Lausanne, is scientific secretary for the European Strategy Session of the CERN Council and chair of the European Strategy and Preparatory Groups.

![ilc newsline]

DIRECTOR'S CORNER

Special Linear Collider Event during the IEEE Symposium

Barry Barish | 8 November 2012



IEEE Linear Collider Event meeting poster

The 2012 Institute of Electrical and Electronics Engineers (IEEE) Nuclear Science Symposium and Medical Imaging Conference, together with the Workshop on Room-Temperature Semiconductor X-Ray and Gamma-Ray Detectors was held in at the Disneyland Hotel (Anaheim California), from 29 October to 3 November. A feature of this year's symposium was a "Special Linear Collider Event." The special event came on the heels of the discovery of the Higgs-like particle at CERN's LHC and had an array of leaders in the field. There were presentations on the International Linear Collider (ILC) and Compact Linear Collider (CLIC) accelerator as well as detector concepts, the potential impact of the LC technologies for industrial applications and a forum discussion about future LC perspectives.

We particle physicists work in a very exciting field, where our discoveries now make front-page news around the world. But, our field is also very expensive, requires huge particle accelerators and large sophisticated detectors to push its frontiers. The LHC is a wonderful example of worldwide collaboration to jointly build such a very large forefront instrument and then jointly pursue the science. The community is now contemplating future machines beyond the LHC, including a complementary electron linear collider like the ILC. To realise our ambitions, we must convince our fellow scientists and engineers of these investments. The IEEE Special Linear Collider Event was just such an opportunity to present the science and technology of linear colliders to this important community, and in that respect we put our best foot forward.

The IEEE Nuclear Science Symposium series started in 1954 and has become one of the largest annual events in the areas of nuclear and particle physics instrumentation, along with the IEEE Medical Imaging Conference (MIC). The one-week meeting typically attracts more than 2,000 leading detector physicists, engineers and industrial companies from all over the world.


Hitoshi Murayama, Director of the Kavli Institute for the Physics and Mathematics of the Universe, Tokyo

A highlight of the event was a featured talk by Hitoshi Murayama on Physics of the Linear Colliders that appealed to both the broader audience at IEEE and to those of us involved in the field. We are very fortunate that Hitoshi has agreed to be part of the new Linear Collider management that will replace the present ILC organisation and integrate the ILC and CLIC efforts, following the completion of the ILC *Technical Design Report*.

The two-day Special Linear Collider (LC) Event was organised as part of this year's NSS Symposium, and included presentations on both the International Linear Collider and the Compact Linear Collider accelerator, detector concepts, the impact of LC technologies for industrial applications, and a forum discussion on LC perspectives. The reviews of ILC and CLIC traced the history of developing the concepts and technologies, and the associated talks on industrial applications were tailored for this audience. Finally, the special event ended with a forum discussion that included Rolf-Dieter Heuer, CERN, Joachim Mnich, DESY, Atsuto Suzuki, KEK, Stuart Henderson, Fermilab, Steiner Stapnes, CERN, Akira Yamamoto, KEK, and Hitoshi Yamamoto. The round table discussion began with Atsuto Suzuki presenting the context of the recent discovery of the Higgs-like particle at CERN and the emerging initiative toward a linear collider in Japan. The discussion then focused on issues like organising global collaboration, involving industry, technology transfer and impacts on society.

Maxim Titov, Special Linear Collider Event organiser

On behalf of our LC community, I would like to thank Maxim Titov, 2012 IEEE NSS Program Chair, and Ingrid-Maria Gregor, 2012 IEEE NSS Deputy Program Chair, for organising this very interesting symposium.

CLIC | IEEE | ILC | INDUSTRY | LINEAR COLLIDER

feature
October 30, 2012

What else could the Higgs be?

According to the Standard Model, the mass of the Higgs boson should be enormous. But recent experimental results suggest it's quite small, indicating that scientists might need to go beyond the Standard Model to explain the new particle.

Ashley WennersHerron and Kathryn Jepsen

On July 4, scientists around the world popped open champagne bottles and toasted the culmination of nearly five decades of research. They had discovered a new particle, one that looked awfully similar to the long-sought Higgs boson.

The Higgs boson has for decades been the last missing piece of the Standard Model of particle physics. But even if the new particle completes the puzzle, some of its pieces still refuse to fit.

"If it's the Standard Model Higgs boson, the picture will be complete, but it won't be satisfying," says Eilam Gross, co-convener of the ATLAS Higgs physics group. "There are questions we can only begin to answer by going beyond the Standard Model."

As the theory tells it, particles gain mass by wading through a kind of force field. Imagine holding a handful of sand. Cup your hands together and apply some pressure. Open your hands. If the sand is dry, it shifts and dissipates. If it's wet, it'll hold the shape you pressed it into. The idea is the same for how particles gain mass. Just as the sand gains a new shape depending on its level of moisture, particles gain mass depending on their level of interaction with the Higgs field.

In return, the Higgs boson gains mass through its interactions with other particles—and through its interactions with itself.

Interactions with one group of particles add huge amounts of mass to the Higgs, and interactions with another, smaller group of particles subtract it. When the math is done, the mass of the Higgs should add up to an astronomical number. Considering this, the mass at which scientists found the possible Higgs, about 125 gigaelectronvolts, is surprisingly small.

If the particle is indeed a Higgs boson, theories beyond the Standard Model can account for its confusing mass. Three popular explanations involve the ideas of supersymmetry, compositeness and extra dimensions.

The supersymmetric Higgs: More new particles

One way to tweak the calculation of the Higgs mass is to add new variables into the equation. The theory of supersymmetry postulates that every elementary particle has a partner particle. Conveniently, each of these partner particles has an opposite effect on the Higgs mass. One partner adds to the mass; the other takes it away.

But they don't completely cancel one another out. The partner particles in theories of supersymmetry are super-partners, particles

that mirror the particles in the original Standard Model set but have more mass. When you add super-partners to the mix, the math of the Higgs mass nearly balances out.

"That's one of the reasons everyone loves supersymmetry," says Fermilab physicist Don Lincoln, who is part of the CMS experiment at the Large Hadron Collider and the DZero experiment at the Tevatron.

Another reason is that, if scientists find that this new boson is a supersymmetric Higgs, they'll know a whole new collection of partner particles is out there, waiting to be found. One of those super-partners, a massive particle called a neutralino, might even turn out to be dark matter, the mysterious substance thought to make up about 25 percent of our universe.

The composite Higgs: Even smaller particles

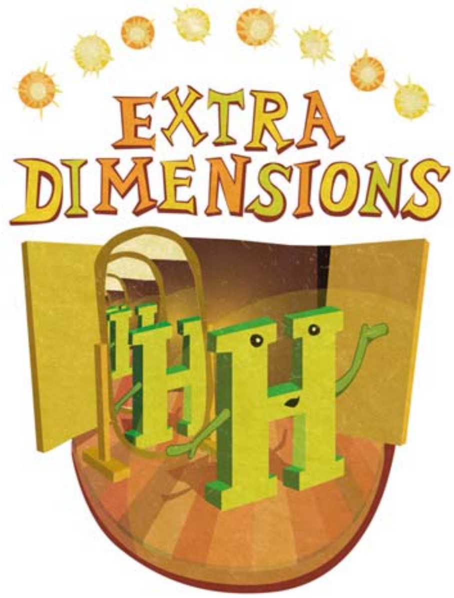
Some theorists have proposed a different solution for the Higgs' unexpected mass. They're exploring the idea of a composite Higgs particle—a particle that behaves like the Standard Model Higgs boson, but is made up of even smaller particles.

Calculating the mass of a composite Higgs particle would be different from calculating the mass of a fundamental, unbreakable Higgs. If the Higgs were made up of tinier pieces, its mass would consist of the mass of those pieces plus the energy of the force holding them together. That could add up to 125 gigaelectronvolts.

A composite Higgs would shake up the world of particle physics. If the Higgs were made up of smaller particles, other particles we currently view as the fundamental building blocks of the universe could be made up of smaller particles as well. Compositeness could birth a new layer of fundamental physics, from which completely new theories would spring.

Extra dimensions: New worlds

A third explanation for the seeming lightness of the Higgs is that we simply are not seeing it all because we're not studying it in all of its dimensions.



"If I do a calculation in three-dimensional space, I get a different answer than if I do a calculation in five-dimensional space," says Fermilab theorist Joe Lykken. "The effects you thought were going to be large [in three-dimensional space] now are not large."

Scientists explain the weakness of gravity in a similar fashion. Gravity may keep us on the ground, but compared to the other forces in our universe, it's a total wimp. If gravity were as strong as the other forces, even a coffee mug would be too heavy for a person to lift.

But it might be that the force of gravity actually exists in more than just three dimensions of space. It only seems weak because not all of its force resides in dimensions we can detect.

In the same way, the calculations that predict a huge mass for the Higgs could be tempered by the effect of dimensions beyond our own.

Discovering extra dimensions could help scientists understand gravity and its relation to the other forces in the universe. It could also embolden string theorists, whose theories expand our universe into at least 11 dimensions of space.

The excitement builds

Even if the new particle is the Standard Model Higgs, "we will still have questions," says CERN theorist Christophe Grojean. "Just adding one more fundamental particle does not bring us the fundamental answer."

That's because the Standard Model is not the theory of everything. With the confirmation of the Standard Model Higgs boson, the theory would be whole—but not comprehensive. Scientists would still need to solve the mysteries of dark energy, dark matter and the weakness of gravity, among others.

Finding out that the new particle is not a Standard Model Higgs—or finding out that it's not a Higgs at all—could offer scientists a roadmap of where to search next. "If it's the Standard Model Higgs boson, that's great, but it doesn't offer any experimental clues of where we should look next," says Albert De Roeck, co-convener of the CMS Higgs physics group.

The story of the new, Higgs-like particle is far from over, a fact that's keeping the excitement at the LHC palpable. Physicists are eager to see where the data takes them next.